13. (NEW) The apparatus of claim 12 including an after-conditioning unit for subsequently conditioning said lignocellulosic boards and generating a stream of suction air, a heater for heating said stream of suction air, and supply means for supplying said heated stream of suction air to said hot air unit.

14. (NEW) The apparatus of claim 12 including transport means for transporting said steam and gaseous emissions to a combustion plant.

REMARKS

Applicants submitted a Preliminary Amendment on May 1, 2001, which included a revised Abstract and revised Specification to replace the Abstract and Specification in the original application. By an official action dated January 31, 2002, a Notice of Non-Complaint Amendment was issued with respect to the failure to submit a marked-up version of the revised Abstract. In response thereto, applicants hereby re-submit the Preliminary Amendment as filed on May 1, 2001, and include therewith the required marked-up Abstract. As noted in that Preliminary Amendment, the above-noted cancellation of claims 1-6, and addition of new claims 7-14, as well as the submission of a revised Abstract and revised Specification, are respectfully submitted prior to initiation of the prosecution of this application in the U.S. Patent and Trademark Office.

The above-noted new claims are respectfully submitted in order to more clearly and appropriately claim the subject matter which applicants consider to constitute their inventive contribution. No new matter is included in these amendments. In addition, the revisions to the Abstract and Specification are submitted in order to clarify and correct the Abstract and Specification and to conform them to all of the requirements of U.S. practice. No new matter is included in these amendments.

In view of the above, it is respectfully requested that these amendments now be entered, and that prosecution on the merits of this application now be initiated. If, however, for any reason the Examiner does not believe such action can be

taken, it is respectfully requested that he telephone applicant's attorney at (908) 654-5000 in order to overcome any objections which he may have.

If there are any additional charges in connection with this requested amendment, the Examiner is authorized to charge applicant's Deposit Account No. 12-1095 therefor.

Respectfully submitted,

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METHOD AND ARRANGEMENT FOR THE CONTINUOUS PRODUCTION OF LIGNOCELLULOSE-CONTAINING BOARDS

FIELD OF THE INVENTION

[0001] The present invention relates to a method of ~~producing~~ continuously producing lignocellulosic boards ~~in accordance with the preamble of claim 1~~, and to ~~an arrangement~~ apparatus for carrying out ~~the~~ such a method.

BACKGROUND OF THE INVENTION

[0002] Methods of producing boards from lignocellulose-based raw materials are well known ~~to~~ in the art and have, in fact, found wide use in practice. The manufacture of such boards includes the following ~~main~~ principle method steps: disintegration of the raw material ~~to fibres~~ into fibers and/or particles of appropriate size, drying the particles and/or ~~fibres~~ fibers to a predetermined moisture ratio, and gluing the material either prior to or subsequent to ~~said~~ the drying process, shaping the glued material to form a mat, which may comprise several layers, and optionally cold pre-pressing the mat, pre-heating ~~said~~ the mat, water-spraying mat surfaces ~~etc.~~, and heat pressing the mat in a discontinuous press or in a continuous press while subjecting the material simultaneously to pressure and heat so as to obtain a finished board.

[0003] A well-known problem with this present day manufacturing technology, irrespective of whether it involves discontinuous presses or continuous presses, is that gases are generated in the press during the compression process, which takes place at high temperatures. These gases consist of water vapour (steam), different volatile substances dissolved from wood and glue, so-called Volatile Organic Compounds (VOC), and gaseous phenol from wood and glue, etc. It has been found that long-time exposure to these substances results in irritation, and that they are also harmful to personal health when present in sufficiently high concentrations. Consequently, the authorities in the majority of those countries in which boards

are manufactured in accordance with the aforesaid methods have ~~elaborated~~ established a set of rules and regulations that state the emission concentrations that are permitted in work places and the ~~permitted~~ concentrations permitted in emissions to the atmosphere.

[0004] Since present day press technology involves the use of homogenous heating plates or steel bands, only a minor part of the gases generated in a press will leave the boards through their edges in the compression process. However, the major part of these gases will leave the board as it exits from the press. The influence of these gases on the working environment can be limited to some extent with the aid of protective casings and covers, although air at room temperature is normally used as transport air because of the large size of the presses. Consequently, this ~~air~~ volume of air will normally exceed the requirement of combustion air in the standard heating plant of the factory. This has necessitated the installation of complicated and expensive equipment in connection with the majority of plants in which lignocellulosic sheets and boards are produced. For instance, the plants will normally include so-called RTO (Regenerated Thermal Oxidizer) units or scrubber systems for purifying press gases.

[0005] ~~The~~ One object of the present invention is to provide a method and ~~an arrangement~~ apparatus for producing lignocellulosic boards without VOC-emissions or formaldehyde-emissions to the workshop areas concerned, and to the ambient environment, and also obviating the need to install expensive purification equipment. ~~This object is achieved with a method and an arrangement according to the invention that have the characteristic features set forth in respective claims.~~

SUMMARY OF THE INVENTION

[0006] In accordance with the present invention, these and other objects have now been realized by the invention of a method for producing lignocellulosic boards from a mat of lignocellusic material comprising compressing the mat in a

steam injection press to form the lignocellulosic boards and produce steam and gaseous emissions therein, capturing the steam and gaseous emissions, and supplying hot air to the steam injection press, whereby condensation of the steam, the gaseous emissions, and any leakage of air from the surroundings is prevented. Preferably, the method includes transporting the steam and gaseous emissions to a combustion plant. In a preferred embodiment, the combustion plant has a predetermined required amount of combustion air, and the method includes supplying the hot air and any of the leakage air to the steam injection press in an amount which is not greater than the predetermined required amount.

[0007] In accordance with another embodiment of the method of the present invention, the supplying of the hot air to the steam injection press includes supplying the hot air to a curing zone in the steam injection press at a temperature of greater than 100°C.

[0008] In accordance with another embodiment of the method of the present invention, the method includes passing the lignocellulosic boards to an after-conditioning unit which generates a stream of suction air, heating the stream of suction air to a temperature greater than 100°C, and using the stream of heated suction air for the supplying of the hot air to the steam injection press.

[0009] In accordance with the present invention, apparatus has been discovered for producing lignocellulosic boards from a mat of lignicellulosic material comprising a steam injection press for compressing the mat to form the lignocellulosic boards and produce steam and gaseous emissions therefrom, a suction member for capturing the steam and gaseous emissions, and a hot air unit for supplying hot air to the steam injection press whereby condensation of the steam, the gaseous emissions, and any leakage air from the surroundings is prevented. Preferably, the apparatus includes an after-conditioning unit for subsequently conditioning the lignocellulosic boards and generating a stream of suction air,

a heater for heating the stream of suction air, and supply means for supplying the heated stream of suction air to the hot air unit.

[0010] In accordance with one embodiment of the apparatus of the present invention, the apparatus includes transport means for transporting the steam and gaseous emissions to a combustion plant.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The present invention will now be described in more detail with reference to the following detailed description which, in turn, refers to the accompanying drawing, which is a side, elevational, partial schematic ~~longitudinal section~~ view of ~~an arrangement~~ apparatus for use in accordance with the method of the present invention.

DETAILED DESCRIPTION

[0012] The plant illustrated in the drawing is based on the plants disclosed in ~~SE~~ Swedish Patent Nos. 502~~,~~,272 and ~~SE~~ 504,638, which describe two continuous steam-press processes. A fibrous mat 1 previously formed in the manufacturing process is compressed in a continuous steam-injection press 2 to form a board or sheet 3, which is then passed through an after-conditioning unit 4. As the ~~fibre~~ fibrous mat 1 passes into the nip between two steam-injection rolls 5, steam is delivered and injected into the mat through wires 6. The temperature rises very quickly to above 100°C~~;~~, with a typical temperature ~~is~~ being above 120°C. The mat is ~~herewith~~ thus formed into a solid board 3. The pressure falls as the board leaves the nip between the steam-injection rolls 5, and the temperature ~~therewith~~ thus drops very quickly to about 100°C. This takes place by virtue of the extremely rapid vaporisation of part of the enclosed moisture. VOC-emissions and formaldehyde-emissions accompany the departing steam.

[0013] Because this process takes place between two gas-permeable wires 6, the steam and the gases departing with the steam are able to leave the board across ~~the whole of~~ its entire width. Steam and other emissions are captured before

being able to escape into the workshop area or to ambient atmosphere, by a suction unit 8 provided to this end inside the press. Air heated to a temperature in excess of 100°C is transported to this suction unit. The hot air is used together with leakage air from the surroundings as a gaseous vehicle ~~gas—~~for the steam and said other emissions. The hot air, leakage air, steam and emissions are transported to a heating plant 9 in the factory, for combustion. A hot air delivery unit 11 is connected to a curing zone 10 in the press 2, and the hot air supplied is then passed to the suction unit 8.

[0014] The temperature is maintained at a high level partly in order to prevent the emissions and the steam from condensing out to the suction system, and partly in order to utilize the fact that the moisture carrying capacity of the air, calculated per kilogram of air, increases with increasing temperatures. This enables the total air volumes and gas volumes to be maintained at levels which do not exceed the volumes of combustion air that are required by the standard plant system to generate the heat and process steam necessary for the production of such board material. Consequently, no other equipment need be installed to prevent emissions to the surroundings.

[0015] Subsequent to the board having been produced in the continuous steam injection press 2, the board is passed into the after-conditioning unit 4 (see ~~SE—~~Swedish Patent No. 504,638) where a pre-determined volume of air heated to a pre-determined temperature and having a pre-determined moisture content is sucked through the board so as to obtain a desired board moisture content and temperature. The air leaving the after-conditioning unit will also contain emissions of VOC and formaldehyde, although in smaller quantities; i.e., measurements taken in a pilot plant have shown that the major part of the emissions occur in the continuous steam-injection press. For this purpose, a suction unit 12 is arranged in the after-conditioning unit 4. Air is sucked in at 13 and heated

by a heater 14 and is supplied with steam through the conduit 15.

[0016] The air leaving the after-conditioning unit is transported to the hot air supply unit 11 of the steam-injection press 2 and its curing zone 10, by means of a suction fan 16. As it passes to the supply unit 11, the air is given additional energy through the medium of a heat exchanger 17. If the air from the after-conditioning unit 4 is in excess, the excess can be mixed with the flow from the press 2 in a closed hood 18 and passed to the heating plant 9. If there is a deficiency of air to the curing zone 10, the suction fan 16 draws-in extra air through the closed hood 18. The air leaving the after-conditioning unit 4 is thus used as hot input air for the internal suction unit 8 of the continuous steam-injection press. Measurements have shown that these volumes are sufficient to fulfil the requisite transport volumes needed for the continuous steam-injection press.

[0017] Subsequent to having passed through the after-conditioning unit 4, the board 3 may optionally also be passed through a surface-densifying press in accordance with ~~SE~~ Swedish Patent No. 502—,272 (not shown in the drawing). This latter press also includes a special suction unit that functions to capture in said press those emissions that are transported to the combustion plant of the factory with the aid of hot air, for the production of heat and steam.

[0018] Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

ABSTRACT OF THE DISCLOSURE

Methods are disclosed for producing boards from mats of lignocellulosic material including compressing the mat in a steam engine press to form the boards and produce steam and gaseous emissions, capturing the steam and gaseous emissions, and supplying hot air to the steam injection press whereby condensation of the steam, the gaseous emissions and any leakage of air from the surroundings is prevented. Apparatus for producing lignocellulosic boards from mats of lignocellulosic material are also disclosed.

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ABSTRACT OF THE DISCLOSURE

~~The present invention relates to a method and an arrangement for the continuous production of lignocellulosic boards, wherein material is disintegrated into particles and/or fibres, glued, dried and formed into a mat (1). The mat is pressed in a continuous steam-injection press (2) into board form (3) and then passed through an after conditioning unit (4). Gaseous emissions and steam occurrent in the press process are captured. Hot air is supplied to prevent condensation of the gaseous emissions and the steam when leakage air from the surroundings is admixed therewith and also to transport the steam and emissions to a combustion plant for combustion.~~Methods are disclosed for producing boards from mats of lignocellulosic material including compressing the mat in a steam engine press to form the boards and produce steam and gaseous emissions, capturing the steam and gaseous emissions, and supplying hot air to the steam injection press whereby condensation of the steam, the gaseous emissions and any leakage of air from the surroundings is prevented. Apparatus for producing lignocellulosic boards from mats of lignocellulosic material are also disclosed.